PRICE $1.00

HEATH COMPANY
BENTON HARBOR, MICHIGAN

HEATHKIT®
ASSEMBLY MANUAL

HEATHKIT®

RESISTANCE SUBSTITUTION BOX

MODEL IN-12

RESISTOR COLOR CODES

The colored bands around the body of a color coded resistor represent its value in ohms. These colored bands are grouped toward one end of the resistor body. Starting with this end of the resistor, the first band represents the first digit of the resistance value; the second band represents the second digit; the third band represents the number by which the first two digits are multiplied. A fourth band of gold or silver represents a tolerance of ±5% or ±10% respectively. The absence of a fourth band indicates a tolerance of ±20%.

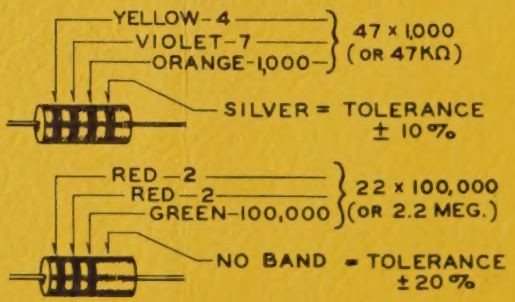
The physical size of a composition resistor is related to its wattage rating. Size increases progressively as the wattage rating is increased. The diameters of 1/2 watt, 1 watt and 2 watt resistors are approximately 1/8", 1/4" and 5/16", respectively.

The color code chart and examples which follow provide the information required to identify color coded resistors.

CODE

COLOR	1ST DIGIT	2ND DIGIT	MULTIPLIER
BLACK	0	0	1
BROWN	1	1	10
RED	2	2	100
ORANGE	3	3	1,000
YELLOW	4	4	10,000
GREEN	5	5	100,000
BLUE	6	6	1,000,000
VIOLET	7	7	10,000,000
GRAY	8	8	100,000,000
WHITE	9	9	1,000,000,000
GOLD	-	-	.1
SILVER	-	-	.01

EXAMPLES



USING A PLASTIC NUT STARTER

A plastic nut starter offers a convenient method of starting the most used sizes: 3/16" and 1/4" (3-48 and 6-32). When the correct end is pushed down over a nut, the pliable tool conforms to the shape of the nut and the nut is gently held while it is being picked up and started on the screw. The tool should only be used to start the nut.

Assembly and Operation of the HEATHKIT® RESISTANCE SUBSTITUTION BOX

MODEL IN-12

HEATH COMPANY,
BENTON HARBOR,
MICHIGAN

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HEATHKIT®

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SPECIFICATIONS

Range	15 ohms to 10 megohms.
Accuracy	±10% EIA values.
Power Rating	1 watt, all values.
Voltage Rating	500 volts continuous.
Dimensions	6" long x 3" wide x 3" high.
Shipping Weight	2 lbs.

DESCRIPTION

The Model IN-12 Resistance Substitution Box was designed to provide a rapid and flexible means of determining the resistance values required in electronic circuits.

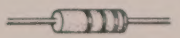
The "shorting type" switches with make-before-break action permit smooth selection of the resistance values without opening or shorting the circuit.

The HI-LO switch makes it possible to switch from one range switch to the other for high or low value resistances. Each resistance value that can be selected is marked by value on the front panel. All values are EIA standards so that resistors of the same values can be obtained.

PARTS LIST

Unpack the kit carefully and check each part against the Parts List. The numbers in parentheses in the Parts List correspond to the numbers of the parts drawings to aid in quick and positive parts identification.

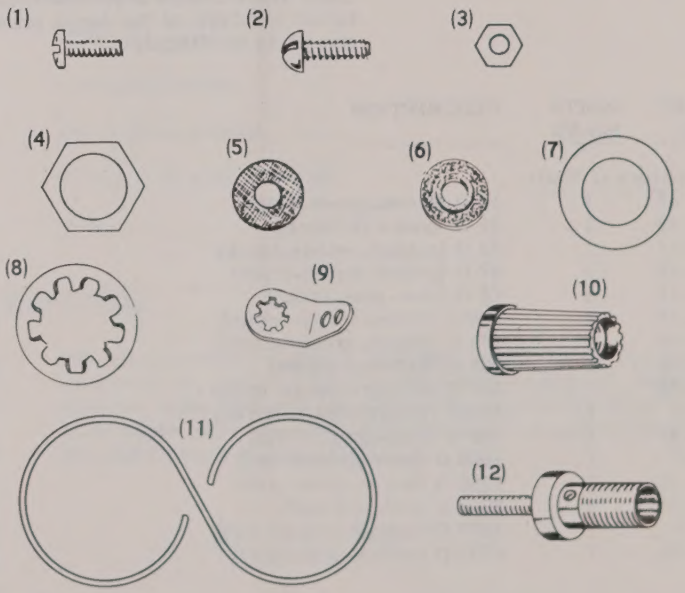
PART No.	PARTS Per Kit	DESCRIPTION
Resistors (1 Watt)		
(1) 1A-12	1	15 Ω (brown-green-black)
1A-13	1	22 Ω (red-red-black)
1A-14	1	33 Ω (orange-orange-black)
1A-15	1	47 Ω (yellow-violet-black)
1A-16	1	68 Ω (blue-gray-black)
1A-17	1	100 Ω (brown-black-brown)
1A-18	1	150 Ω (brown-green-brown)
1A-19	1	220 Ω (red-red-brown)
1A-20	1	330 Ω (orange-orange-brown)
1A-1	1	470 Ω (yellow-violet-brown)
1A-21	1	680 Ω (blue-gray-brown)
1A-2	1	1000 Ω (brown-black-red)
1A-22	1	1500 Ω (brown-green-red)
1A-23	1	2200 Ω (red-red-red)
1A-3	1	3300 Ω (orange-orange-red)
1A-24	1	4700 Ω (yellow-violet-red)

(1) 

PART No.	PARTS Per Kit	DESCRIPTION
Resistors (1 Watt) (cont'd.)		
1A-25	1	6800 Ω (blue-gray-red)
1A-9	1	10 KΩ (brown-black-orange)
1A-26	1	15 KΩ (brown-green-orange)
1A-5	1	22 KΩ (red-red-orange)
1A-27	1	33 KΩ (orange-orange-orange)
1A-7	1	47 KΩ (yellow-violet-orange)
1A-8	1	68 KΩ (blue-gray-orange)
1A-28	1	100 KΩ (brown-black-yellow)
1A-29	1	150 KΩ (brown-green-yellow)
1A-30	1	220 KΩ (red-red-yellow)
1A-31	1	330 KΩ (orange-orange-yellow)
1A-32	1	470 KΩ (yellow-violet-yellow)
1A-33	1	680 KΩ (blue-gray-yellow)
1A-34	1	1 megohm (brown-black-green)
1A-35	1	1.5 megohm (brown-green-green)
1A-36	1	2.2 megohm (red-red-green)
1A-37	1	3.3 megohm (orange-orange-green)
1A-38	1	4.7 megohm (yellow-violet-green)
1A-39	1	6.8 megohm (blue-gray-green)
1A-40	1	10 megohm (brown-black-blue)

PART No.	PARTS Per Kit	DESCRIPTION
Hardware		
(1) 250-213	4	4-40 x 5/16" screw
(2) 250-9	2	6-32 x 3/8" screw
(3) 252-3	2	6-32 nut
(4) 252-7	2	Control nut
(5) 253-1	2	Fiber flat washer
(6) 253-2	2	Fiber shoulder washer
(7) 253-10	2	Control flat washer
(8) 254-4	2	Control lockwasher
(9) 259-1	2	Solder lug
Miscellaneous		
60-4	1	SPDT slide switch
63-38	2	Rotary switch
(10) 100-M16B	2	Binding post cap
203-M415F	782,783,784	
	1	Front panel
(11) 213-M1	1	Resistor mounting ring
408-11	1	Case
(12) 427-2	2	Binding post base
462-187	2	Knob
344-59	1	Hookup wire
331-6		Solder
595-571	1	Manual

PARTS PICTORIAL



ASSEMBLY NOTES

The following instructions are presented in a logical step-by-step sequence to enable you to complete your kit with the least possible confusion. Be sure to read each step all the way through before beginning the specified operation. Also read several steps ahead of the actual step being performed. This will familiarize you with the relationship of the subsequent operations. When the step is completed, check it off in the space provided. This is particularly important, as it may prevent errors or omissions, especially if your work is interrupted.

In general, the illustrations in this manual correspond to the actual configuration of the kit; however, in some instances the illustrations may be slightly distorted to facilitate clearly showing all of the parts.

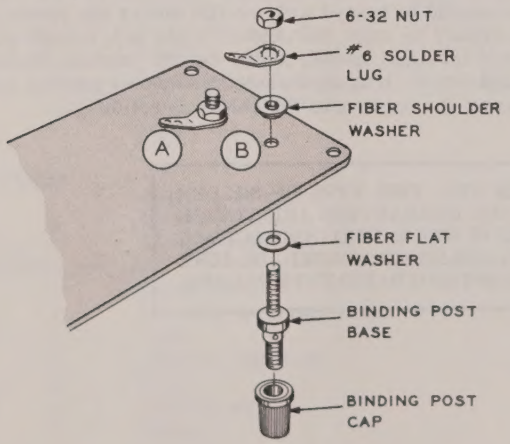
When soldering, position the work, if possible, so that gravity will help to keep the solder where you want it. The joint to be soldered should be heated with the flat side of the soldering iron tip sufficiently to melt the solder. Apply only enough solder to the heated terminal to thoroughly wet the junction. Remove the solder and then the iron when a smooth soldered junction appears. Do not move the leads until the solder is solidified.

ROSIN CORE SOLDER HAS BEEN SUPPLIED WITH THIS KIT. THIS TYPE OF SOLDER MUST BE USED FOR ALL SOLDERING IN THIS KIT. ALL GUARANTEES ARE VOIDED AND WE WILL NOT REPAIR OR SERVICE EQUIPMENT IN WHICH ACID CORE SOLDER OR PASTE FLUXES HAVE BEEN USED. IF ADDITIONAL SOLDER IS NEEDED, BE SURE TO PURCHASE ROSIN CORE (60:40 or 50:50 TIN-LEAD CONTENT) RADIO TYPE SOLDER.

STEP-BY-STEP ASSEMBLY

Refer to Pictorial 1 for the following steps.

( ) Mount binding posts at A and B on the front panel. Use the fiber shoulder washers, fiber flat washers, solder lugs, and 6-32 nuts as shown in Detail 1A. Position the solder lugs as shown.

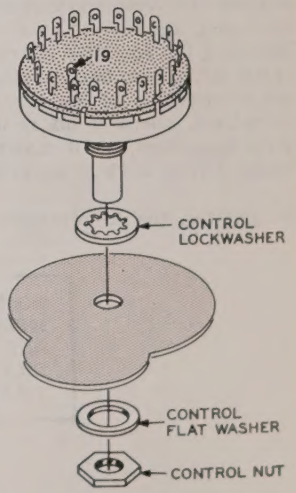


Detail 1A

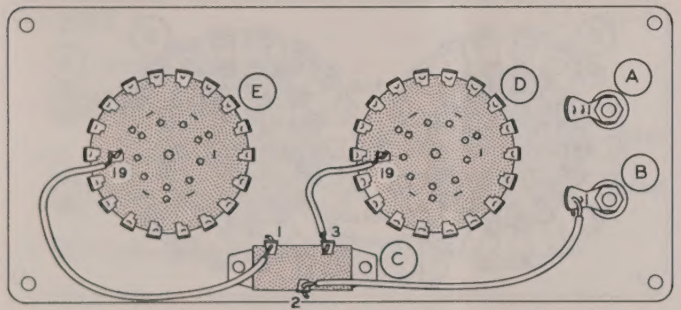
( ) Install binding post caps on the binding posts at A and B.

( ) Mount the SPDT slide switch (#60-4) at location C on the front panel. Use two 6-32 x 3/8" screws.

( ) Refer to Detail 1B and mount the two rotary switches at D and E. Use control lockwashers, control flat washers, and control nuts. Position lug 19 of each switch as shown.



Detail 1B



Pictorial 1

( ) Install the knobs on switches D and E. Look into the edge of each switch and notice where the wiper contact of the switch is located. Then place the knob on the switch shaft so that the pointer is directly over the wiper lug. Then tighten the knob setscrew. Make sure the knob pointer lines up properly with the front panel markings when the switch is rotated through its positions. It may be necessary to loosen the setscrew and reposition the knob slightly.

( ) Cut three hookup wires, one 1-1/2", one 3-3/4", and one 3". Remove 1/4" of insulation from the ends of these wires.

( ) Solder a 1-1/2" wire from lug 19 of switch D to lug 3 of switch C.

( ) Solder a 3-3/4" wire from lug 19 of switch E to lug 1 of switch C.

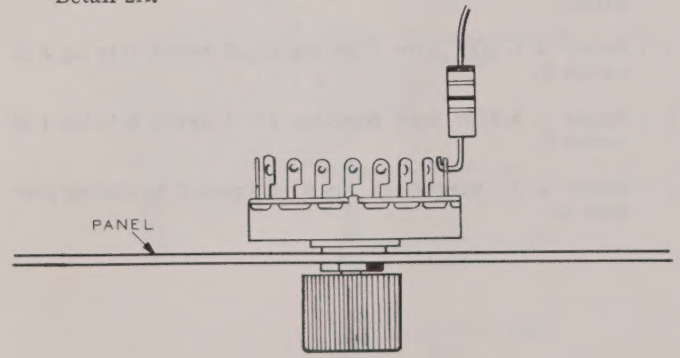
( ) Solder a 3" wire from lug 2 of switch C to binding post base B.

Refer to Pictorial 2 for the following steps.

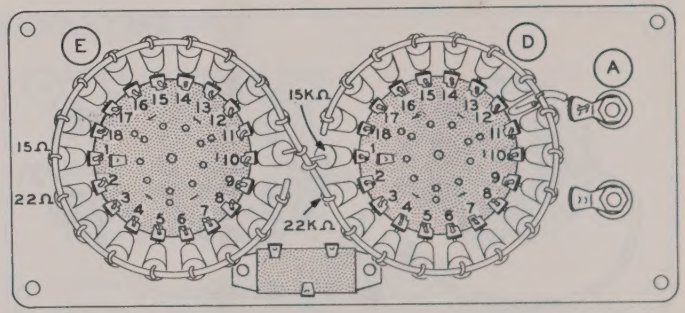
NOTE: The major portion of the wiring consists of connecting the resistors between the rotary switches and the resistor mounting ring. This wiring should be done as neatly as possible, and as instructed.

( ) Cut one lead of each resistor to 3/8". The other lead of the resistor should not be cut.

( ) Form a hook in the cut lead of each resistor. Refer to Detail 2A.



Detail 2A



Pictorial 2

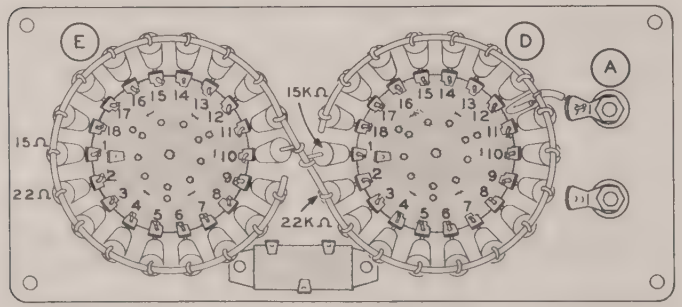
( ) Arrange the resistors in order starting with the lowest value, 15 Ω (brown-green-black) and proceed to the highest value, 10 megohm (brown-black-blue). The resistors are listed in this sequence in the Parts List.

Connect the resistors to rotary switch E according to the following chart. Position each resistor so that the resistor lead hooks into the switch lug from the outside, then solder. Refer to Detail 2A. The resistor mounting ring will be installed after all the resistors are connected to the switches.

CONNECT A	TO LUG
( ) 15 Ω (brown-green-black)	1
( ) 22 Ω (red-red-black)	2
( ) 33 Ω (orange-orange-black)	3
( ) 47 Ω (yellow-violet-black)	4
( ) 68 Ω (blue-gray-black)	5
( ) 100 Ω (brown-black-brown)	6
( ) 150 Ω (brown-green-brown)	7
( ) 220 Ω (red-red-brown)	8
( ) 330 Ω (orange-orange-brown)	9
( ) 470 Ω (yellow-violet-brown)	10
( ) 680 Ω (blue-gray-brown)	11
( ) 1000 Ω (brown-black-red)	12
( ) 1500 Ω (brown-green-red)	13
( ) 2200 Ω (red-red-red)	14
( ) 3300 Ω (orange-orange-red)	15
( ) 4700 Ω (yellow-violet-red)	16
( ) 6800 Ω (blue-gray-red)	17
( ) 10 KΩ (brown-black-orange)	18

In the same manner, install the remaining resistors on rotary switch D, as follows:

CONNECT A	TO LUG
( ) 15 KΩ (brown-green-orange)	1
( ) 22 KΩ (red-red-orange)	2
( ) 33 KΩ (orange-orange-orange)	3
( ) 47 KΩ (yellow-violet-orange)	4
( ) 68 KΩ (blue-gray-orange)	5
( ) 100 KΩ (brown-black-yellow)	6
( ) 150 KΩ (brown-green-yellow)	7
( ) 220 KΩ (red-red-yellow)	8
( ) 330 KΩ (orange-orange-yellow)	9



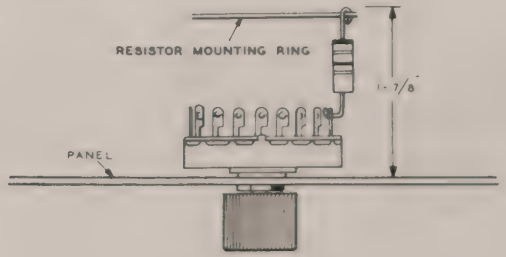
Pictorial 2
(Repeat)

CONNECT A	TO LUG
( ) 470 KΩ (yellow-violet-yellow)	10
( ) 680 KΩ (blue-gray-yellow)	11
( ) 1 megohm (brown-black-green)	12
( ) 1.5 megohm (brown-green-green)	13
( ) 2.2 megohm (red-red-green)	14
( ) 3.3 megohm (orange-orange-green)	15

CONNECT A	TO LUG
( ) 4.7 megohm (yellow-violet-green)	16
( ) 6.8 megohm (blue-gray-green)	17
( ) 10 megohm (brown-black-blue)	18

( ) Slip the resistor mounting ring over the resistor mounted on the rotary switches. The resistors should be placed on the inside of each circle as shown in Detail 2B. The mounting ring should be pushed close to the resistor bodies and the leads bent around the mounting ring to make a good mechanical connection. Cut off the excess resistor lead lengths. Now flow solder smoothly over each joint.

( ) Solder a 2" wire from binding post base A to the resistor mounting ring.



Detail 2B

( ) Refer to Pictorial 3 and mount the front panel in the case with the 4-40 x 5/16" screws. Do not overtighten the screws or you may damage the case.

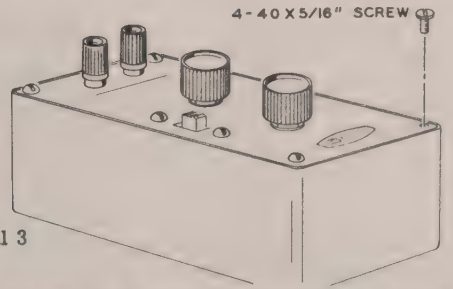
This completes assembly.

NOTE: The blue and white identification label shows the Model Number and Production Series Number of your kit. Refer to these numbers in any communications with the Heath Company; this assures you that you will receive the most complete and up-to-date information in return.

( ) Install the identification label in the following manner:

1. Select a location for the label where it can easily be seen when needed, but will not show when the unit is in operation. This location might be on the rear panel or the top of the chassis, or on the rear or bottom of the cabinet.

2. Carefully peel away the backing paper. Then press the label into position.



Pictorial 3

APPLICATIONS

In radio or television service work, the Heathkit Resistance Substitution Box will prove of great assistance in experimentally determining the desired value of a charred or unmarked resistor through temporary substitution. It can also be substituted for any resistor in a circuit so that the value of the resistor may be changed during operation in order to determine the desired resistance value that will provide maximum circuit performance. No attempt will be made to detail all of the various applications; through continued usage many additional applications of the Resistance Substitution Box will suggest themselves to the serviceman.

In laboratory or circuit development work, the Resistance Substitution Box will prove invaluable. The advantages of using several Resistance Substitution Boxes are obvious, as any change in a circuit constant usually requires a corresponding change in some other component. By having Resistance Substitution Boxes connected in the plate, grid, cathode or screen supply circuits, the entire experimental setup can be quickly changed.

Because the Heathkit Resistance Substitution Box kit uses standard EIA values, it is possible to select from your working stock the exact resistor needed for any application. The resistors used are all rated at 1 watt and this rating should not be exceeded in use. The continuous operating voltage rating of 500 volts should be observed to prevent a flashover within the unit.

IN CASE OF DIFFICULTY

1. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the constructor.

2. It is interesting to note that about 90% of the kits that are returned for repair do not function properly due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure that they are soldered properly.

3. Check the values of the component parts. Be sure that the proper part has been wired into the circuit, as shown in the pictorial diagrams and as called out in the wiring instructions.

4. Check for bits of solder, wire ends or other foreign matter which may be lodged in the wiring.

5. An ohmmeter can be used to check the resistance values as the switches are turned to each position. Make sure the knob pointers line up properly with the markings on the panel.

SERVICE INFORMATION

SERVICE

If, after applying the information in this manual and your best efforts, you are still unable to obtain proper performance, it is suggested that you take advantage of the technical facilities which the Heath Company makes available to its customers.

The Technical Consultation Department is maintained for your benefit. This service is available to you at no charge. Its primary purpose is to provide assistance for those who encounter difficulty in the construction, operation or maintenance of HEATHKIT equipment. It is not intended, and is not equipped to function as a general source of technical information involving kit modifications nor anything other than the normal and specified performance of HEATHKIT equipment.

Although the Technical Consultants are familiar with all details of this kit, the effectiveness of their advice will depend entirely upon the amount and the accuracy of the information furnished by you. In a sense, YOU MUST QUALIFY for GOOD technical advice by helping the consultants to help you. Please use this outline:

1. Before writing, fully investigate each of the hints and suggestions listed in this manual under In Case Of Difficulty. Possibly it will not be necessary to write.

2. When writing, clearly describe the nature of the trouble and mention all associated equipment. Specifically report operating procedures, switch positions, connections to other units, and anything else that might help to isolate the cause of trouble.

3. Report fully on the results obtained when testing the unit initially and when following the suggestions under In Case Of Difficulty. Be as specific as possible.

4. Identify the kit Model Number and Series Number, and date of purchase, if available. Also mention the date of the kit assembly manual. (Date at bottom of Page 1.)

5. Print or type your name and address, preferably in two places on the letter.

With the preceding information, the consultant will know exactly what kit you have, what you would like it to do for you and the difficulty you wish to correct. The date of purchase tells him whether or not engineering changes have been made since it was shipped to you. He will know what you have done in an effort to locate the cause of trouble and, thereby, avoid repetitious suggestions. In short, he will devote full time to the problem at hand, and through his familiarity with the kit, plus your accurate report, he will be able to give you a complete and helpful answer. If replacement parts are required, they will be shipped to you, subject to the terms of the Warranty.

The Factory Service facilities are also available to you, in case you are not familiar enough with electronics to provide our consultants with sufficient information on which to base a diagnosis of your difficulty, or in the event that you prefer to have the difficulty corrected in this manner. You may return the completed equipment to the Heath Company for inspection and necessary repairs and adjustments. You will be charged a minimal service fee, plus the price of any additional parts or material required. However, if the completed kit is returned within the Warranty period, parts charges will be governed by the terms of the Warranty. State the date of purchase, if possible.

Local Service by Authorized HEATHKIT Service Centers is also available in some areas and often will be your fastest, most efficient method of obtaining service. HEATHKIT Service Centers will honor the regular 90 day HEATHKIT Parts Warranty on all kits, whether purchased through a dealer or directly from the Heath Company; however, it will be necessary that you verify the purchase date of your kit.

Under the conditions specified in the Warranty, replacement parts are supplied without charge; however, if the Service Center assists you in locating a defective part (or parts) in your kit, or installs a replacement part for you, you may be charged for this service.

HEATHKIT equipment purchased locally and returned to Heath Company for service must be accompanied by your copy of the dated sales receipt from your authorized HEATHKIT dealer in order to be eligible for parts replacement under the terms of the Warranty.

THIS SERVICE POLICY APPLIES ONLY TO COMPLETED EQUIPMENT CONSTRUCTED IN ACCORDANCE WITH THE INSTRUCTIONS AS STATED IN THE MANUAL. Equipment that has been modified in design will not be accepted for repair. If there is evidence of acid core solder or paste fluxes, the equipment will be returned NOT repaired.

For information regarding modification of HEATHKIT equipment for special applications, it is suggested that you refer to any one or more of the many publications that are available on all phases of electronics. They can be obtained at or through your local library, as well as at most electronic equipment stores. Although the Heath Company sincerely welcomes all comments and suggestions, it would be impossible to design, test, evaluate and assume responsibility for proposed circuit changes for special purposes. Therefore, such modifications must be made at the discretion of the kit builder, using information available from sources other than the Heath Company.

REPLACEMENTS

Material supplied with HEATHKIT products has been carefully selected to meet design requirements and ordinarily will fulfill its function without difficulty. Occasionally, improper operation can be traced to a faulty component. Should inspection reveal the necessity for replacement, write to the Heath Company and supply all of the following information.

A. Thoroughly identify the part in question by using the part number and description found in the manual Parts List.

B. Identify the kit Model Number and Series Number.

C. Mention date of purchase.

D. Describe the nature of defect or reason for requesting replacement.

The Heath Company will promptly supply the necessary replacement. PLEASE DO NOT RETURN THE ORIGINAL COMPONENT UNTIL SPECIFICALLY REQUESTED TO DO SO. Do not dismantle the component in question as this will void the guarantee. This replacement policy does not cover the free replacement of parts that may have been broken or damaged through carelessness on the part of the kit builder.

SHIPPING INSTRUCTIONS

In the event that your instrument must be returned for service, these instructions should be carefully followed.

Wrap the equipment in heavy paper, exercising care to prevent damage. Place the wrapped equipment in a stout carton with shredded paper, excelsior, or other resilient packing material between all sides of the wrapped equipment and the carton. Close and seal the carton with gummed paper tape, or alternately, tie securely with stout cord. Clearly print the address on the carton as follows:

To: HEATH COMPANY
Benton Harbor, Michigan 49023

ATTACH A LETTER TO THE OUTSIDE OF THE CARTON BEARING YOUR NAME, COMPLETE ADDRESS, DATE OF PURCHASE, AND A BRIEF DESCRIPTION OF THE DIFFICULTY ENCOUNTERED. Also, include your name and return address on the outside of the carton. Preferably affix one or more "Fragile" or "Handle With Care" labels to the carton, or otherwise so mark with a crayon of bright color. Ship by insured parcel post or prepaid express; note that a carrier cannot be held responsible for damage in transit if, in HIS OPINION, the article is inadequately packed for shipment.

WARRANTY

Heath Company warrants that all Heathkit parts shall be free of all defects in materials and workmanship under normal use and service, and in fulfillment of such warranty Heath Company will, for a period of three months from the date of shipment, replace any part upon verification that it is defective.

The foregoing warranty shall apply only to the original buyer, and is and shall be in lieu of all other warranties, whether express or implied and of all other obligations or liabilities on the part of Heath Company and in no event shall Heath Company be liable for any anticipated profits, consequential damages, loss of time or other losses incurred by the buyer in connection with the purchase, assembly or operation of Heathkits or components thereof. No replacement shall be made of parts damaged by the buyer in the course of handling or assembling Heathkit equipment.

The foregoing warranty is completely void if corrosive solder or fluxes have been used in wiring the equipment. Heath Company will not replace or repair any equipment in which corrosive solder or fluxes have been used.

This warranty applies only to Heath equipment sold and shipped within the continental United States including APO and FPO shipments. Warranty replacement for Heathkit equipment outside the United States is on an f.o.b. factory basis. Contact the Heathkit authorized distributor in your country or write: Heath Company, International Division, Benton Harbor, Michigan, U.S.A.

HEATH COMPANY

CAPACITOR COLOR CODES

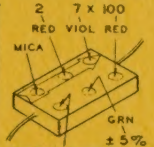
Generally, only mica and tubular ceramic capacitors, used in modern equipment, are color coded. The color codes differ somewhat among capacitor manufacturers, however the codes shown below apply to practically all of the mica and tubular ceramic capacitors that are in common use. These codes comply with EIA (Electronics Industries Association) Standards.

MICA

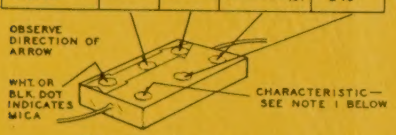
CODE

COLOR	1ST DIGIT	2ND DIGIT	MULTIPLIER	TOLER. %
BLACK	0	0	1	±20
BROWN	1	1	10	—
RED	2	2	100	± 2
ORANGE	3	3	1,000	± 3
YELLOW	4	4	10,000	—
GREEN	5	5	—	± 5
BLUE	6	6	—	—
VIOLET	7	7	—	—
GRAY	8	8	—	—
WHITE	9	9	—	—
GOLD	-	-	.1	—
SILVER	-	-	.01	± 10

EXAMPLE



2,700 µµf ± 5 %
OR .0027 µfd



(VALUE IN µµf—SEE NOTE 3 BELOW)

TUBULAR CERAMIC

Place the group of rings or dots to the left and read from left to right.

CODE

COLOR	1ST DIGIT	2ND DIGIT	MULTIPLIER	TOLER. % 10 OR LESS	TOLER. % OVER 10
BLACK	0	0	1	± 2.0	±20
BROWN	1	1	10	± 0.1	± 1
RED	2	2	100	—	± 2
ORANGE	3	3	1,000	—	± 2.5
YELLOW	4	4	10,000	—	—
GREEN	5	5	—	± 0.5	± 5
BLUE	6	6	—	—	—
VIOLET	7	7	—	—	—
GRAY	8	8	—	± 0.25	—
WHITE	9	9	—	± 1.0	±10

EXAMPLE

(VALUE IN µµf—SEE NOTE 3 BELOW)

NOTES:

1. The characteristic of a mica capacitor is the temperature coefficient, drift capacitance and insulation resistance. This information is not usually needed to identify a capacitor but, if desired, it can be obtained by referring to EIA Standard, RS-153 (a Standard of Electronic Industries Association.)

2. The temperature coefficient of a capacitor is the predictable change in capacitance with temperature change and is expressed in parts per million per degree centigrade. Refer to EIA Standard, RS-198 (a Standard of Electronic Industries Association.)

3. The farad is the basic unit of capacitance, however capacitor values are generally expressed in terms of µfd (microfarad, .000001 farad) and µµf (micro-micro-farad, .000001 µfd); therefore, 1,000 µµf = .001 µfd, 1,000,000 µµf = 1µfd.

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